New York Space Grant Consortium
Lead Inst.: Cornell University
Director: Prof. Yervant Terzian
Phone: (607) 255-2710
http://astro.cornell.edu/spacegrant/
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PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The New York Space Grant Consortium is a Designated Consortium funded at a level of $845,000 for fiscal year 2010 (April 23, 2010 – April 22, 2011).

PROGRAM GOALS

The New York Space Grant (NYSG) Consortium aims to inspire, engage, and educate students in science, technology, engineering, and math (STEM) disciplines, and to prepare students across NY State to be the future workforce for NASA and other high-technology industries. The specific SMART objectives tied to the following consortium goals are listed at the end of the Program Accomplishments section:

NYSG Goal #1: Our NASA Education Outcome 1 programs (Fellowship/Scholarship, Higher Education, and Research Infrastructure) will positively impact the **diversity** of students entering the STEM workforce and pursuing advanced STEM degrees.

NYSG Goal #2: Our NASA Education Outcome 1 programs (Fellowship/Scholarship, Higher Education, and Research Infrastructure) will positively impact the **number** of students entering the STEM workforce and pursuing advanced STEM degrees.

NYSG Goal #3: Our consortium will help build NY State higher education-industry collaborations, while assisting with high technology workforce development to decrease the "brain drain" afflicting NY State.

NYSG Goal #4: Our NASA Education Outcome 2 (Precollege Education) programs will attract and retain students in STEM disciplines though K-12 teacher professional development and K-12 student opportunities.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, OR 3)

Examples of NYSG benefits to Outcome 1 (Fellowship/Scholarship and Higher Education):
Female undergraduate supported by NYSG for two summers; she has been accepted to at least three graduate astrophysics programs – "I can identify my experience at Kitt Peak National Observatory as the distinguishing occasion that made me realize I would be studying astronomy for the rest of my life. I was fortunate enough to experience two weeklong observation runs at the WIYN 0.9m telescope, one in June of 2009 and the other in June of 2010. These unique opportunities to operate a professional telescope and to take my own data made me want to pursue graduate studies in order to eventually make my own contribution to science."

Current female NYSG undergraduate – "[This Space Grant award] definitely encouraged me to get involved in research early on in my undergraduate years. Without the grant I probably would have considered getting involved in research much later in my undergraduate career because I didn't think that it was common for freshmen to be involved. Instead, I was able to get early exposure to scientific methods and what it's like to work in a laboratory setting. … I think this program provided a great opportunity for 'early undergraduates' to get involved in research. I found that it was very hard to find research opportunities as a freshman (ones that don't merely involve beaker cleaning/lab maintenance) and most mentors encourage younger students to take research for credit. I was glad that I had the option of getting a grant for research so that I could focus and adjust to doing research in college rather than juggling jobs to make ends meet."

Example of NYSG benefits to Outcome 2 (Precollege):
A middle school teacher participating in the NY Space Grant Teacher Fellows Program listed at least seven different lessons and activities he had conducted with his students using the NASA information and materials provided. He reported: "The engagement and interest in the above stated lessons was incredible!!! The students were eager to learn and explore! I am going to be including these lessons in next year's classes as well. Previously my solar system/universe unit was very small ...having this wealth of information available to include in my unit has given it a real science feel and current science meaning!! Thank you so much."

Example of NYSG benefits to Outcome 3 (Informal Education):
As part of the NY Space Grant NASA Lecture Series, an astrophysicist gave a presentation at a NYC public school. The elementary schoolchildren wrote in their thank-you note: "Thank you for coming into our class as a guest speaker. You were really fun when you were teaching us. We really liked the song [about gravity and black holes], now we keep singing it because it's fun."

PROGRAM ACCOMPLISHMENTS

Outcome 1 [Fellowship/Scholarship, Higher Education, and Research Infrastructure programs] – Many opportunities to help develop the STEM workforce in disciplines needed to achieve NASA's strategic goals were provided in FY2010. Space Grant-supported undergraduate and graduate students conducted a wide array of STEM research (e.g., aeronautical, biomedical, electrical, and mechanical engineering; computer science/engineering; atmospheric sciences; physics; astronomy and space sciences; and mechatronics/robotics) during the academic year and summer at **all** NYSG colleges/universities. CUNYSAT, led by NYSG affiliate Medgar Evers College (MEC), involved students from multiple City University of New York campuses designing, building, and testing a CubeSat that is scheduled to launch on a Falcon 9 rocket in June 2012. Participating students, the vast majority of whom are underrepresented minorities, gained hands-on experience while learning NASA systems engineering principles and best practices. The participation of NASA personnel and contractors serving as CUNYSAT reviewers and advisors has also provided potential opportunities for internships and employment. The NYSG-supported MECSAT program also continued to engage students in hands-on atmospheric research using ozonesondes launched on high-altitude balloons. A new relationship between affiliates MEC and Rensselaer Polytechnic Institute has evolved, with the MEC affiliate director advising students in Rensselaer's high altitude balloon project on various technical issues and best practices; a joint launch might be attempted in the spring if conditions allow. Seven students, from six different NYSG institutions, were sponsored for summer 2010 internships at NASA Ames, Jet Propulsion Laboratory, Kennedy, Langley, and Marshall. A new Space Grant summer internship was established at Moog Space and Defense, located in western New York. Two engineering students participated in this new opportunity, one funded by NYSG and the other by Moog. Another new NYSG program funded one male and seven female early undergraduate students' faculty-mentored STEM research during the academic year. Awards were given for exceptional student achievements in a NASA FAST (Facilitated Access to the Space environment for Technology) project and a submillimeter astrophysics project. NYSG supported student travel to conduct research (e.g., Kitt Peak National Observatory), and also supported students' travel and participation in various conferences (e.g., National Conferences on Undergraduate Research, SpaceVision 2010).

Outcome 1 [Research Infrastructure and Higher Education] – As a result of NYSG's FY2010 Competition for Research Initiation and Higher Education Enhancement Grants, a total of six projects were supported at four institutions (Cornell University, Polytechnic Institute of NYU, Rensselaer Polytechnic Institute, and Rochester Institute of Technology). Interdisciplinary projects included research on milligram-scale spacecraft technology for use on planetary science missions, the effect of aircraft wingtip vortices approaching the ground at oblique angles, broadening female students' doctoral training in mechatronics/robotics and outreach, development of a high-speed optical photometer that can be built cheaply with off-the-shelf components and used on small telescopes,

novel use of neuromorphic devices for spacecraft inertial and relative navigation, and evaluating tetrahertz spectroscopy as a technique for non-destructive characterization of biomarkers on planetary sub-surfaces. This competition seeded or matured NASA-related research at those institutions, enabling the principal investigators to establish new collaborations, build prototypes, and become more competitive in space-related fields.

Outcome 2 [Precollege] – The brand-new NY Space Grant Teacher Fellows Program was very successful. Middle school STEM teachers from anywhere within NY State were eligible to apply; sixteen teachers from eleven cities in upstate NY and the NYC area were accepted and participated in the program. The Teacher Fellows remotely attended three science webinars so far, on topics requested by the teachers, given by Cornell staff and graduate students who are directly involved in NASA research. During a two-day conference at Cornell, the Teacher Fellows received NASA curricular materials and supplies for their classrooms, gained practice with hands-on science activities to conduct with students, and attended tours and talks about current NASA research (e.g., Mars rovers imaging lab, Stardust-NExT mission). Through a brand-new partnership with the Science Teachers Association of New York State (STANYS), NASA-themed professional development workshops were provided to science educators (grades 7-12) across the state. Over 250 teachers have attended NYSG-supported workshops on lunar samples, astrobiology, and the MESSENGER mission so far; more of these workshops are planned. The Sciencenter ran a full-day professional development workshop in which 25 teachers received materials and were trained to create their own science kits that use literacy as an entry point. Sciencenter staff provided support after this workshop to help teachers implement the hands-on science kits in their classrooms. Other pre-college projects supported by NYSG include the Buffalo-area Engineering Awareness for Minorities (BEAM) program to educate and engage post-10^{th} and 11^{th} grade minority students in engineering, the Central NY Rocket Team Challenge and Bridge Build'em and Bust'em events run by the Museum of Science and Technology (MOST) and Syracuse University, and Polytechnic Institute of NYU's Science and Mechatronics Aided Research for Teachers project, which recently gained more support from a local foundation to potentially triple the number of under-resourced Brooklyn school teachers researching/designing hands-on robotics lessons for their classrooms. With Space Grant support, MOST had planned a special event for middle school science classes to learn about scientific research conducted aboard the International Space Station (ISS) and the importance of STEM careers, and to interact directly with ISS crew via a pre-arranged audiovisual downlink within MOST's IMAX theater. Unfortunately the MOST application to NASA's Teaching From Space program, requesting the educational downlink during the Expedition 27/28 mission, was not successful.

Outcome 3 [Informal Education] – The NY Space Grant NASA Lecture Series, a brand-new program, aimed to bring presentations on NASA-related STEM topics, STEM careers, and/or NASA mission activities to secondary schools and 2-year colleges throughout urban and rural areas of NY State. Conducted by faculty affiliated with NYSG institutions, a total of six lectures have been given, with two more already scheduled and potentially four others being arranged before the end of FY2010. In the

heart of New York City, Columbia University's astronomy outreach program demonstrated a strong follow-up to last year's IYA efforts. Nearly 4,000 people attended 40 events including science fiction movie screenings followed by science fact vs. fiction discussions, school group visits, family astro events, urban sidewalk astronomy in Harlem neighborhoods, and a lunar eclipse observing event in the middle of campus that drew approximately 300 people. Space Grant-supported students were involved in outreach activities at other affiliates: Alfred University summer interns helped with public observing nights and served as assistants for a high school summer astronomy institute, while Space Grant students led outreach activities for K-12 school and civic groups at Colgate University's Visualization Lab/Planetarium, Union College students visited secondary schools in disadvantaged neighborhoods to give physics demonstrations and discuss careers in physics, and Medgar Evers College students gave presentations on their NASA projects and conducted BalloonSat and rocket launching workshops for a group of 200 middle school students. Such hands-on engagement in outreach activities and service-learning experiences complement the Space Grant students' fellowship/scholarship/research efforts and personal growth.

- **NASA 2010 Education Priorities:** In fiscal year 2010, NYSG programs contributed to the following priorities *[italicized]* identified by NASA:

  - *Authentic, hands-on student experiences in science and engineering disciplines:* NY students benefited from research and internship opportunities at all NYSG institutions, NASA centers, and Moog Space and Defense. Medgar Evers College involved predominantly underrepresented minority students in hands-on BalloonSAT and CubeSAT projects.
  - *Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise:* NYSG Space Grant Teacher Fellows Program, Polytechnic's SMART (Science and Mechatronics Aided Research for Teachers) program, and the STANYS Teacher Workshop Program engaged middle school STEM teachers.
  - *Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers:* The Buffalo-area Engineering Awareness for Minorities (BEAM) program engaged post-10^{th} and 11^{th} grade minority students in faculty-mentored engineering and computer science projects at SUNY Buffalo. During summer 2010, Medgar Evers College's high altitude balloon project involved four local high school students (working with college students) in conducting 15 ozonesonde launches in conjunction with a tropospheric ozone research project.
  - *Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges:* The NY Space Grant NASA Lecture Series aided both new and existing institutional relationships with two community colleges. Faculty and students from Queensborough Community College collaborated on the Science payload portion of the ongoing CUNYSAT CubeSat project, led by NYSG affiliate Medgar Evers College. At the request of NASA and the Virginia Space Grant Consortium, in December 2010 NYSG hosted a funding/proposal writing workshop for the

Innovations in Global Climate Change Education (IGCCE) program at affiliate York College, located in the very diverse Queens section of the NYC metro area. New relationships were formed with chemistry and physics professors from Bronx Community College and Queensborough Community College.

- *Aeronautics research – research in traditional aeronautics disciplines, areas appropriate to NASA's unique capabilities, and needs of the Next Generation Air Transportation System (NextGen):* Through a NYSG Research Grant, the effect of aircraft wingtip vortices approaching the ground at oblique angles (e.g., during take-off and landing) is being studied. NYSG-funded undergraduates at Syracuse University conducted research in areas such as the potential use of a cross-flow fan to create very large lift coefficients needed for short take-off and landing (STOL) airplanes, and computational fluid dynamics. Clarkson University's NYSG affiliate director helps advise undergraduates involved in micro-air vehicles, inflatable UAVs, and the development of a desktop flight simulator.
- *Environmental Science and Global Climate Change – research and activities to better understand Earth's environments:* Medgar Evers College's BalloonSAT program engaged students from diverse science backgrounds in ozone research; these students gained hands-on experience collecting and analyzing data related to global climate change and local environmental impacts. SUNY Geneseo students continued to work on an atmospheric sensor system that builds upon technology used to detect carbon dioxide aboard the Space Shuttle.
- Diversity of institutions, faculty, and student participants: As shown in the last section of this report, the NY Space Grant Consortium includes a wide variety of institutions, spread throughout upstate NY and the New York City area, with diverse faculty from many different STEM fields serving as affiliate directors.
- *Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities:* NYSG Research Initiation Grants have enabled early career faculty to further their research in NASA priority areas, and increase prospects for additional funding to sustain their research beyond the Space Grant support.

During FY2010 NYSG made the following progress towards meeting its SMART goals/objectives:

1. The percentage of NYSG underrepresented minority student awardees (monetary and non-monetary) per budget year shall meet or exceed the adjusted minority enrollment percentage in NY higher education institutions (26.6%). In FY2010 the percentage of underrepresented minority students who participated in NYSG fellowship/scholarship, higher education, and research infrastructure projects was 19.3%. However, out of the subset of significant awardees this year, 20.3% were minorities.

2. The percentage of NYSG female student awardees (monetary and non-monetary) per budget year shall meet or exceed 38% (based on STEM bachelor's degrees awarded to females nationwide). In FY2010 the percentage of female students who participated in NYSG fellowship/scholarship, higher education, and research

infrastructure projects was 38%, hence we met this goal for total participants, and exceeded it in the subset of significant awards (43% significant awardees were female.)

3. NYSG shall strive for 90% or more of graduating significant awardees to take the next step to STEM employment or advanced STEM degrees. Based on data from longitudinal tracking, of the 50 significant awardees who have graduated since their involvement in NYSG programs, 44 are pursuing STEM advanced degrees or are employed in STEM positions, 4 are seeking STEM employment, and 2 are in non-STEM pursuits. Hence for this reporting period, the percentage of significant awardees who have taken their next step to STEM advanced degrees or employment is 88%, almost meeting our goal. Note that an additional 8% of graduated significant awardees are seeking STEM employment – this might be an effect of the current slow economy.

4. NYSG shall add 2-3 more industrial affiliates in New York State by the end of the 2010-2015 grant period. We are making progress toward this goal, as we engaged two more companies (Moog Space and Defense, and Honeybee Robotics) in providing NASA-related summer 2010 internships for NYSG students.

5. Following their involvement in NYSG precollege programs, at least 75% of K-12 teachers participating in long-duration (≥2 days) training will utilize NASA resources in their classroom instruction. Of the sixteen NY Space Grant Teacher Fellows, 100% have already used the NASA resources in their classrooms or report specific plans to use them before the current school year is over.

6. Following their involvement in NYSG precollege programs, at least 60% of K-12 teachers participating in short-duration training will utilize NASA resources in their classroom instruction. We plan to collect and analyze teacher data at the conclusion of the STANYS Teacher Workshop Program.

7. Following their involvement in NYSG precollege programs, at least 50% of K-12 students will express interest in STEM careers. We plan to collect and analyze data at the conclusion of our pre-college programs that involve direct student participation.

PROGRAM CONTRIBUTIONS TO PART MEASURES

- Student Data and Longitudinal Tracking: Total FY2010 student participants = 109; Fellowship/Scholarship = 51, Higher Education & Research Infrastructure = 58; underrepresented minority participants = 21; female participants = 41; students with disabilities = 3. Of the 50 students who have graduated since receiving FY2006 to FY2010 NYSG significant awards, 27 are pursuing advanced STEM degrees, 5 are in STEM positions at aerospace contractors, 10 are in STEM positions at non-aerospace companies, and 2 are in STEM academic/higher education positions.
- Course Development: None reported to date for FY2010.
- Matching Funds: For FY2010, the ratio of NYSG non-federal matching funds to NASA Space Grant funds (excluding the portion not requiring a match) was at least 1:1.
- Minority-Serving Institutions: Three NYSG affiliates are minority-serving institutions: CUNY City College of New York, CUNY Medgar Evers College, and CUNY York College. While SUNY Stony Brook is not a minority institution, NYSG is partnered with its Louis Stokes Alliance for Minority Participation (LSAMP)

program to provide underrepresented minorities with NASA-related research opportunities with Stony Brook faculty. Medger Evers College's Space Grant affiliate director collaborates with other minority-serving institutions (such as South Carolina State University and the University of Houston-Downtown) on her NYSG-supported MECSAT ozone research project, thus expanding the impact of Space Grant funding.

IMPROVEMENTS MADE IN THE PAST YEAR

In the past year, aided by augmentation funds, we offered new **state-wide** programming in pre-college (e.g., NY Space Grant Teacher Fellows Program, STANYS NASA-themed teacher workshops) and informal education (NASA Lecture Series at secondary schools and community colleges). In addition to facilitating continued NASA-related summer internship placements at Lockheed Martin (in central NY) and Honeybee Robotics (in New York City), this year a new Space Grant summer internship was established at Moog Space and Defense Group, located in western New York. For the upcoming summer, NYSG is facilitating and/or sponsoring NASA-related summer internships at Lockheed Martin, Honeybee Robotics, Moog, and another new company: Crestron Electronics.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

1. **Alfred University**, Alfred, NY *[highly residential, Master's I, private]* undergraduate research and F/S
2. **Barnard College**, New York, NY *[highly residential, Baccalaureate - Liberal Arts, private]* **liberal arts college for women,** undergraduate research and F/S
3. **CUNY City College of NY**, New York, NY *[primarily nonresidential, Master's I, public]* **Minority Serving Institution,** graduate research and F/S
4. **CUNY Medgar Evers College**, Brooklyn, NY *[primarily nonresidential, Baccalaureate - General, public]* **Minority Serving Institution,** undergraduate research and F/S, student balloon (MECSAT) and CubeSat (CUNYSAT) programs
5. **CUNY York College**, Jamaica, NY *[primarily nonresidential, Baccalaureate - General, public]* **Minority Serving Institution,** undergraduate research and F/S
6. **Clarkson University**, Potsdam, NY *[highly residential, Doctoral/Research - Intensive, private]* undergraduate and graduate research and F/S
7. **Colgate University**, Hamilton, NY *[highly residential, Baccalaureate - Liberal Arts, private]* undergraduate research and F/S, general public
8. **Columbia University**, New York, NY *[highly residential, Doctoral/Research - Extensive, private]* undergraduate and graduate research and F/S, general public

9. **Cornell University**, Ithaca, NY *[primarily residential, Doctoral/Research - Extensive, private and public (land grant)]* **NYSG lead institution**, undergraduate and graduate research and F/S, other consortium-wide projects such as summer internship programs, precollege, and informal education
10. **Lockheed Martin**, Owego, NY – Aerospace industry affiliate providing student internships.
11. **Polytechnic Institute of New York University**, Brooklyn, NY *[primarily nonresidential, Doctoral/Research - Intensive, private]* undergraduate and graduate research and F/S, precollege
12. **Rensselaer Polytechnic Institute**, Troy, NY *[highly residential, Doctoral/Research - Extensive, private]* undergraduate and graduate research and F/S
13. **Rochester Institute of Technology**, Rochester, NY *[highly residential, Master's I, private]* graduate research and F/S
14. **Sciencenter**, Ithaca, NY – Non-profit informal education affiliate, precollege and undergraduate training
15. **SUNY Binghamton**, Binghamton, NY *[highly residential, Doctoral/Research – Extensive, public]* undergraduate research and F/S
16. **SUNY Buffalo**, Buffalo, NY *[primarily residential, Doctoral/Research - Extensive, public]* graduate research and F/S, precollege
17. **SUNY Geneseo**, Geneseo, NY *[highly residential, Master's I, public]* undergraduate research and F/S
18. **SUNY Stony Brook**, Stony Brook, NY *[highly residential, Doctoral/Research - Extensive, public]* **NYSG is partnered with the LSAMP program which runs minority-focused projects,** undergraduate research and F/S
19. **Syracuse University**, Syracuse, NY *[highly residential, Doctoral/Research - Extensive, private]* undergraduate research and F/S, involved in precollege and informal education with the Museum of Science & Technology (MOST) in Syracuse
20. **Union College**, Schenectady, NY *[highly residential, Baccalaureate - Liberal Arts, private]* undergraduate research and F/S, precollege
21. **University of Rochester**, Rochester, NY *[highly residential, Doctoral/Research - Extensive, private]* undergraduate and graduate research and F/S